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## NUCLEAR CHEMISTRY REVIEW SHEET

nswer the following questions on this sheet or in your composition notebook:

### sotopes/Atomic Structure Review

1. What particles make up the nucleus of an atom? _____ & _____
2. What does the atomic number of an atom represent? _____
3. What does the mass number of atom represent? _____
4. What is an isotope? _____
5. Calculate the number of neutrons in Iodine – 131. _____
6. Write the isotopic formula for Iodine – 131. _____

### Stability and Nuclear Forces

7. In a **chemical** reaction, how do atoms achieve stability? _____
8. In a **nuclear** reaction, how do atoms achieve stability? _____
9. What two forces are present in the nucleus of an atom? _____ & _____
10. What force causes two protons to repel? _____
11. If protons naturally repel each other, what particle acts like the "glue" that holds the nucleus together? _____
12. The strong nuclear force is an attraction between _____ and _____.
13. At short distances, the strong nuclear force is _____, but at long distances, the strong nuclear force _____.
14. At the short distances, the electrostatic force is _____ and at long distances it is _____.
15. Stable nuclei have a ratio of protons to neutrons of ___:___.
16. As nuclei get larger, it takes more _____ to stabilize the repulsion of the protons.
17. There are no stable atoms with an atomic number greater than _____.
18. When a nucleus becomes too large, the _____ force disappears. The _____ force is still present, so the protons repel and emit parts of the nucleus called _____.
19. Fill in the following chart for the two forces that hold an atom together.

| Characteristic | Strong Nuclear Force | Electrostatic Force |
|---|---|---|
| Acts between ... | | |
| Attractive or repelling force? | | |
| Strength at long distances | | |
| Strength at short distances | | |

**Radioactivity**

20. All nuclei with an atomic number greater than 83 are said to be unstable, or _____.
21. What is radiation? _____
22. What is radioactive decay? _____
23. What are the three types of radioactive decay? _____ & _____ & _____
24. What type of radiation can be stopped by aluminum foil? _____
25. What type of radiation is essentially just the release of energy? _____
26. What type of radiation is the most massive? _____
27. What is the charge of an alpha particle? _____
28. What is the charge of a beta particle? _____
29. What type of radiation can be stopped by paper? _____
30. Describe the particles that make up an alpha particle. _____
31. A beta particle is released when a _____ decays into a _____ and a _____.
32. How does beta radiation affect atomic mass? _____ Atomic number? _____
33. How does alpha radiation affect atomic mass? _____ Atomic number? _____
34. How does gamma radiation affect atomic mass? _____ Atomic number? _____
35. How many alpha particles are released for the complete decay of Uranium – 238 to Lead – 218? ___
36. How many beta particles are released from the decay of Iodine – 131 to Xenon – 131? ____
37. Three types of radioactive emissions are called alpha (a), beta (b) and gamma (g) radiation. Complete the table below with the correct information about each type.

| | What is it? | Symbol | Can Be Stopped By | Penetrating Power |
|---|---|---|---|---|
| **Alpha** | | | | |
| **Beta** | | | | |
| **Gamma** | | | | |

38. Which of the three radioactive emissions (a, b, g ) best fit the following statements? Write the correct symbol/s on the lines.
    a. These emissions are charged (more than one). _____
    b. This emission is the most massive (heaviest). _____
    c. This emission is the most charged. _____
    d. This emission is most dangerous outside of the body. _____
    e. This emission is stopped by thin paper or a few centimeters of air. _____
    f. This emission can travel through paper, but is stopped by aluminum. _____
    g. This emission can travel through fairly thick lead. _____

39. Which type of radiation – alpha, beta, or gamma:
    a. Results in the greatest change in atomic number? Why?

    b. Results in the least change in atomic number? Why?

c. Produces the greatest change in mass number? Why?

d. Produces the least change in mass number? Why?

40. Alpha radiation is emitted during the disintegration of the following isotopes. Write balanced nuclear equations for their decay processes.

a. uranium-238

b. uranium-240

c. polonium-218

d. polonium-216

41. The following radioisotopes are beta emitters. Write balanced nuclear equation for their decay processes.

a. carbon-14

b. nickel-63

c. nickel-64

42. Complete the following nuclear reactions by re-writing and filling in the missing blanks:

a. $^{226}_{88}Ra \rightarrow {}^{?}_{?}? + {}^{0}_{-1}e$

b. $^{209}_{84}Po \rightarrow {}^{205}_{82}Pb + {}^{?}_{?}?$

c. $^{238}_{92}U \rightarrow {}^{?}_{?}? + {}^{4}_{2}He$

43. When isotope bismuth-213 emits an alpha particle:

a. Write out the nuclear equation:

b. What new element results if the isotope, emits a beta particle instead?

44. When $^{218}_{84}Po$ emits a beta particle, it transforms into a new element.

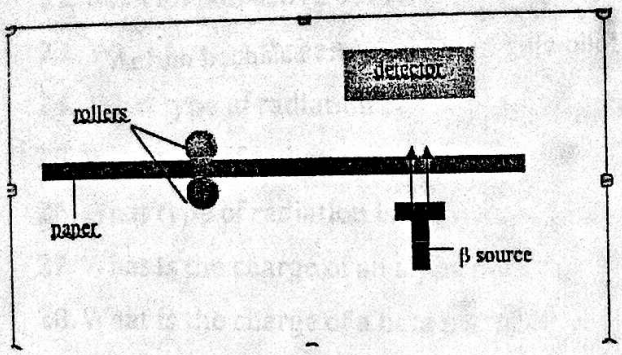
a. Write out the nuclear equation:

b. Fill out the chart below:

| | Name of the Element | Atomic Number | Mass | # Protons | # Electrons | # Neutrons |
|---|---|---|---|---|---|---|
| Parent Element (reactant) | | | | | | |
| Daughter Element (product) | | | | | | |

| Subatomic particle | Symbol | Charge |
|---|---|---|
| Protons | | |

45. In a papermaking factory, beta radiation is used to check that the paper being produced is the correct thickness. If the paper gets too thin, the reading on the detector increases causing the rollers to move apart to make the paper thicker. If the paper gets too thick, the reading on the detector goes down causing the rollers to move closer together. A diagram of this set-up is shown below:




Explain why beta radiation is used for this procedure rather than alpha or gamma radiation.

**Half-life and Radioactive Decay Rates -**

46. What is half-life? _____

47. You have 1000 g of Iodine-131. How much iodine is left after 1 half-life? After 2 half-lives? After 3 half-lives?

48. Carbon 14 has a half-life of 5,730 years. If a sample contains 100g originally, how much is left after 17,190 years?

49. If 100 g of Au-198 decays to 6.25 g 40 days, what is the half-life of Au-198?

**Nuclear Reactions**

50. What is a transmutation? _____

51. Is more energy released in a chemical or nuclear reaction? _____

52. Describe the process of nuclear fission. _____

53. Describe the process of nuclear fusion. _____

54. Describe what happens during a nuclear chain reaction. _____

_____

55. What must be sustained in order for a nuclear chain reaction to occur? _____

56. What nuclear reaction fuels the sun? _____

57. Which nuclear reaction results in the greatest amount of energy released, fission or fusion? _____

**Radiation Today**

58. List 3 sources of background radiation. _____ & _____ & _____

59. What are the units for measuring the amount of radiation exposure? _____